CLAIMS

WHAT IS CLAIMED IS:

1. A method of making a carbon fiber-carbon matrix reinforced ceramic composite, said method comprising:

selecting a plurality of carbon fiber bundles, each of said carbon fiber bundles including a plurality of individual carbon fibers;

forming a preform from said plurality of carbon fiber bundles;

forming a deposit of carbon within said carbon fiber bundles and between said plurality of carbon fiber bundles, said deposits of carbon being formed by chemical vapor deposition using methane precursor;

recovering a resultant open porous carbon fiber-carbon matrix preform from said forming wherein said carbon fiber bundles comprise carbon fiber-carbon matrix composites, and said porous carbon fiber-carbon matrix preform comprises a plurality of said carbon fiber-carbon matrix composites embedded within sacrificial carbon, and said porous carbon fiber-carbon matrix preform having a preform void volume;

placing said porous carbon fiber-carbon matrix preform in contact with a molten infiltrant, said molten infiltrant having a melting point above about 1850 degrees centigrade and being capable of reacting with carbon to form a carbide;

letting said molten infiltrant infiltrate said porous carbon fiber-carbon matrix preform without the application of pressure; and

allowing said sacrificial carbon to react with said molten infiltrant to form a metal carbide matrix, said allowing including permitting said molten infiltrant to react preferentially with said sacrificial carbon and not with said carbon fiber-carbon matrix composites.

2. A method of claim 1 wherein said selecting includes selecting carbon fiber bundles wherein substantially each of said individual carbon fibers has a substantially continuous coating of a metallic oxide thereon.

3. A method of claim 1 wherein said selecting includes selecting carbon fiber bundles wherein substantially each of said individual carbon fibers has a substantially continuous coating of a metallic carbide thereon.

4. A method of claim 1 wherein said selecting includes applying a substantially continuous coating of carbon on each of said individual carbon fibers and exposing the resulting carbon coated fibers to air before said forming.

5. A method of claim 1 including contacting said metal carbide matrix with molten silicon, and permitting said molten silicon to diffuse into said metal carbide matrix.

6. A method of claim 1 wherein said carbon fiber bundles are in the form of tows.

7. A method of claim 1 including contacting said metal carbide matrix with approximately an amount of molten silicon that will diffuse into said metal carbide matrix, and allowing approximately all of said silicon to diffuse into said metal carbide matrix without reacting substantially with said carbon fiber-carbon matrix composites.

8. A method of claim 1 wherein said letting includes providing no more than approximately 25 volume percent more of said molten infiltrant than said preform void volume.

9. A method of claim 1 wherein said placing includes placing said open porous carbon fiber-carbon matrix preform in contact with molten zirconium or hafnium.

10. A method of claim 1 including selecting said infiltrant from alloys of said molten infiltrants.

11. A method of claim 1 wherein said placing includes placing approximately an amount of metal that will react with said sacrificial carbon in said open porous carbon-fiber-carbon matrix preform, and said letting includes allowing said sacrificial carbon to react with approximately all of said metal, and contacting said metal carbide matrix with approximately an amount of molten silicon that will diffuse into said metal carbide matrix, and allowing approximately all of said silicon to diffuse into said metal carbide matrix.

12. A method of claim 11 wherein said contacting includes contacting said metal carbide matrix with an amount of molten silicon that is more than an amount of silicon that will diffuse into said metal carbide matrix.

13. A method of claim 1 wherein said placing includes placing a stoichiometric excess of metal in said open porous carbon-fiber-carbon matrix preform, and said letting includes allowing said sacrificial carbon to react with said metal, and contacting said metal carbide matrix with approximately an amount of molten silicon that will diffuse into said metal carbide matrix.

14. A carbon-carbon reinforced ceramic composite comprising: a carbon-carbon composite comprising a plurality of carbon fibers in a carbon matrix, said carbon-carbon composite being embedded within a carbide matrix comprised of a solid carbide of at least one carbide forming metal having a melting point above about 1850 degrees centigrade.

15. A carbon-carbon reinforced ceramic composite of claim 14 wherein said carbide matrix includes a reaction product of molten silicon diffused into said solid carbide.

16. A carbon-carbon reinforced ceramic composite of claim 14 wherein said carbon matrix is pyrolitic carbon.

17. A carbon-carbon reinforced ceramic composite comprising: a carbon-carbon composite comprising a plurality of carbon fibers in a carbon matrix, said carbon-carbon composite being embedded within a carbide matrix comprised of a solid carbide of at least one metal having a melting point above about 1850 degrees centigrade, said carbide matrix includes a reaction product of molten silicon diffused into said solid carbide, and the ratio of said silicon to said metal in said solid carbide is greater than about 1 to 1.

18. A carbon-carbon reinforced ceramic composite comprising: a carbon-carbon composite comprising a plurality of carbon fibers in a carbon matrix, said carbon-carbon composite being embedded within a carbide matrix comprised of a solid carbide of at least one metal having a melting point above about 1850 degrees centigrade, said carbide matrix includes a reaction product of molten silicon diffused into said solid carbide, and the ratio of said silicon to said metal in said solid carbide is less than about 1 to 1.

19. A carbon-carbon reinforced ceramic composite comprising: a carbon-carbon composite comprising a plurality of carbon fiber bundles in a carbon matrix, said carbon-carbon composite being embedded within a carbide matrix comprised of a solid carbide of at least one Group IV element having a melting point above about 1850 degrees centigrade, and said carbide matrix includes a reaction product of molten silicon diffused into said solid carbide.

20. A carbon-carbon reinforced ceramic composite comprising:

a plurality of carbon fibers in a bundle, and a plurality of said bundles in said carbon-carbon reinforced ceramic composite;

a coating comprised of metal oxide substantially encapsulating each of said carbon fibers;

a formed in situ carbon matrix between said carbon fibers in said bundles; and

a formed in situ carbide matrix between said plurality of bundles comprised of a solid metal carbide of at least one Group IV element having a melting point above about 1850 degrees centigrade, and said carbide matrix includes a reaction product of molten silicon diffused into said solid carbide.

21. A carbon-carbon reinforced ceramic composite comprising:

a carbon-carbon composite comprised of a plurality of carbon fibers in a carbon matrix, and a plurality of said carbon-carbon composites in said carbon-carbon reinforced ceramic composite;

a coating comprised of carbon substantially encapsulating each of said carbon fibers; and

a formed in situ carbide matrix between said plurality of carbon-carbon composites comprised of reaction products of molten silicon diffused into a solid metal carbide of at least one Group IV element having a melting point above about 1850 degrees centigrade.